CLAIMS

What is claimed is:

1. A method of analyzing uncertainties in a system having at least two modules, comprising:

propagating an uncertainty distribution associated with each of a set of inputs through a module to produce an uncertainty in a set of outputs of said module;

generating a probabilistically equivalent model of said module, said equivalent model producing a model of said outputs; and

providing said model of said outputs in a common data architecture for use as inputs by any other module in said system.

2. The method according to claim 1, wherein said probabilistically equivalent model is a deterministically equivalent model.

3. The method according to claim 2, wherein said deterministically equivalent model is a reduced-order model.

4. The method according to claim 1, wherein said propagating said uncertainty distribution uses a Monte Carlo method.

5. The method according to claim 1, wherein at least one of said set of outputs is incorporated into at least one of said set of inputs in a feedback loop.

6. A method of analyzing uncertainties in a system, comprising:

substituting at least one of a plurality modules of a system with a corresponding probabilistically equivalent module model, said equivalent module model adapted to propagate uncertainties in inputs of said module to outputs of said module;

providing outputs of each of said modules in a common data architecture for use as inputs by any other module, said architecture adapted to propagate uncertainties in said outputs to said inputs of said other module; and

substituting said plurality of modules with a single probabilistically equivalent system model for propagating uncertainties in system inputs to system outputs.

7. The method according to claim 6, further comprising:

providing an optimization module for optimizing an objective function, said optimization module adapted to receive said system outputs and to vary said system inputs.

8. The method according to claim 7, wherein said objective function is a weighted function of two or more output parameters.

9. The method according to claim 6, wherein said probabilistically equivalent module model is a deterministically equivalent model.

10. The method according to claim 9, wherein said deterministically equivalent model is a reduced-order model.

11. The method according to claim 6, wherein said probabilistically equivalent system model is a deterministically equivalent model.

12. The method according to claim 11, wherein said deterministically equivalent model is a reduced-order model.

13. A system for generating an uncertainty analysis, comprising:

a module adapted to receive a set of inputs and to produce a set of outputs as a function of said inputs, each of said inputs having an associated uncertainty distribution;

means for propagating said uncertainty distribution of said inputs through said module to produce an uncertainty in said outputs;

means for generating a probabilistically equivalent model of said module, said equivalent model producing model outputs; and

means for providing said outputs in a common data architecture for use as inputs by any other module in said system.

14. The system according to claim 13, wherein said probabilistically equivalent model is a deterministically equivalent model.

15. The system according to claim 14, wherein said deterministically equivalent model is a reduced-order model.

16. The system according to claim 14, wherein said means for propagating said uncertainty distribution uses a Monte Carlo method.

17. A system of analyzing uncertainties in a system, comprising:

means for generating a probabilistically equivalent module model for at least one of a plurality modules of a system, said equivalent module model being adapted to propagate uncertainties in inputs of said module to outputs of said module;

means for providing outputs of each of said modules in a common data architecture for use as inputs by any other module, said architecture adapted to propagate uncertainties in said outputs to said inputs of said other module; and

means for generating a single probabilistically equivalent system model for said

plurality of modules for propagating uncertainties in system inputs to system outputs.

18. The system according to claim 17, further comprising:

an optimization module for optimizing an objective function, said optimization module being adapted to receive said system outputs and to vary said system inputs.

19. The system according to claim 18, wherein said objective function is a weighted function of two or more output parameters.

20. The system according to claim 17, wherein said probabilistically equivalent module model is a deterministically equivalent model.

21. The system according to claim 20, wherein said deterministically equivalent model is a reduced-order model.

22. The system according to claim 17, wherein said probabilistically equivalent system model is a deterministically equivalent model.

23. The system according to claim 22, wherein said deterministically equivalent model is a reduced-order model.

24. A system for generating an uncertainty analysis, comprising:

a modeling module adapted to receive a set of inputs and to produce a set of outputs as a function of said inputs, each of said inputs having an associated uncertainty distribution;

an uncertainty propagation module adapted to propagate said uncertainty distribution of said inputs through said modeling module to produce an uncertainty in

said outputs;

an equivalent model generation module adapted to generate a probabilistically equivalent model of said modeling module, said equivalent model producing said outputs; and

an output generation module adapted to provide said outputs in a common data architecture for use as inputs by any other module.

25. The system according to claim 24, wherein said probabilistically equivalent model is a deterministically equivalent model.

26. The system according to claim 25, wherein said deterministically equivalent model is a reduced-order model.

27. The system according to claim 24, wherein said uncertainty propagation module uses a Monte Carlo method.

28. A system of analyzing uncertainties in a system, comprising:

an equivalent model generation module adapted to generate a probabilistically equivalent subsystem model for at least one of a plurality of subsystems, said equivalent subsystem model being adapted to propagate uncertainties in inputs of said subsystem to outputs of said subsystem;

an output generation module adapted to provide outputs of each of said subsystems in a common data architecture for use as inputs by any other subsystem, said architecture being adapted to propagate uncertainties in said outputs to said inputs of said other subsystem; and

an equivalent system generation module adapted to generate a single probabilistically equivalent system model for said plurality of subsystems for

propagating uncertainties in system inputs to system outputs.

29. The system according to claim 28, further comprising:

an optimization module for optimizing an objective function, said optimization module being adapted to receive said system outputs and to vary said system inputs.

30. The system according to claim 29, wherein said objective function is a weighted function of two or more output parameters.

31. The system according to claim 28, wherein said probabilistically equivalent subsystem model is a deterministically equivalent model.

32. The system according to claim 31, wherein said deterministically equivalent model is a reduced-order model.

33. The system according to claim 28, wherein said probabilistically equivalent system model is a deterministically equivalent model.

34. The system according to claim 33, wherein said deterministically equivalent model is a reduced-order model.

35. A program product, comprising machine readable program code for causing a machine to perform following method steps:

propagating an uncertainty distribution associated with each of a set of inputs through a module to produce an uncertainty in a set of outputs of said module;

generating a probabilistically equivalent model of said module, said equivalent model producing a model of said outputs; and

providing said model of said outputs in a common data architecture for use as inputs by any other module in said system.

36. The program product according to claim 35, wherein said probabilistically equivalent model is a deterministically equivalent model.

37. The program product according to claim 36, wherein said deterministically equivalent model is a reduced-order model.

38. The program product according to claim 35, wherein said propagating said uncertainty distribution uses a Monte Carlo method.

39. A program product, comprising machine readable program code for causing a machine to perform following method steps, comprising:

substituting at least one of a plurality modules of a system with a corresponding probabilistically equivalent module model, said equivalent module model adapted to propagate uncertainties in inputs of said module to outputs of said module;

providing outputs of each of said modules in a common data architecture for use as inputs by any other module, said architecture adapted to propagate uncertainties in said outputs to said inputs of said other module; and

substituting said plurality of modules with a single probabilistically equivalent system model for propagating uncertainties in system inputs to system outputs.

40. The program product according to claim 39, wherein said program code causes a machine to further perform the following method step, further comprising:

providing an optimization module for optimizing an objective function, said optimization module adapted to receive said system outputs and to vary said system

inputs.

41. The program product according to claim 40, wherein said objective function is a weighted function of two or more output parameters.

42. The program product according to claim 39, wherein said probabilistically equivalent module model is a deterministically equivalent model.

43. The program product according to claim 42, wherein said deterministically equivalent model is a reduced-order model.

44. The program product according to claim 39, wherein said probabilistically equivalent system model is a deterministically equivalent model.

45. The program product according to claim 44, wherein said deterministically equivalent model is a reduced-order model.